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NOTES ON THE BIOLOGY OF TWO SPECIES OF NOCTURNAL SKINKS, *EGERNIA INORNATA* AND *EGERNIA STRIATA*, IN THE GREAT VICTORIA DESERT

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INTRODUCTION

Although most members of the lizard family Scincidae are diurnal, a few interesting but little-known Austalian species of *Sphenomorphus* and *Egernia* are nocturnal. Here we report observations made on two skink species of the genus *Egernia* in the Western Australian sector of the Great Victoria Desert during 1966-68 and 1978-79 on a series of ecological study sites (Pianka 1969a, 1969*b*). Cogger (1975) gives approximate range maps showing the geographic distributions of *E. inornata* and *E. striata*, which were recently revised by Storr (1968). *E. Inornata* is figured in Worrell (1963, Plate 18); *E. striata* is shown in Figure 1. Both are medium-sized terrestrial skinks.

HABITAT REQUIREMENTS

These two species are found throughout the sandy parts of the Great Victoria Desert, as well as on somewhat harder soils in shrub-*Acacia* desert habitats. They occur in sympatry in many areas, but *E. Inornata* occurs alone in the dry lakebed of Lake Yeo, and seems to be more abundant on sandridge sites than *E. striata*. *E. inornata* is found farther up sandridges than *E. striata*, which appears to be more restricted to flatland parts of desert areas. On two sandridge study sites, we collected 73 *inornata* and 19 *striata;* approximately half of the former (35 or 36) were on slopes and/or crests of sandridges whereas only one *striata* was not on the flats or at the base of the sandridges.

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Figure 1. An adult *Egernia striata* in sandplain habitat in the Great Victoria Desert.

TIME OF ACTIVITY

E. inornata is crepuscular and occasionally even diurnal in activity as well as nocturnal (its pupil is not elliptical), whereas *E. striata* seems to be largely nocturnal (indeed, it is a rarity among skinks in having an elliptical pupil, usually associated with nocturnality). We have, however, occasionally observed *striata* out of their burrows of their own violition during the daytime — sometimes these emergences seem to be associated with basking (see below), but at other times, usually on overcast days, they are related to abundant food availability when termites are swarming.

These skinks exhibit a marked seasonality in activity: during winter, the lizards hole up and brumate in a blocked-off side tunnel while the remainder of their burrow system falls into disrepair.

BURROWS

These *Egernia* are accomplished diggers; perhaps the most conspicuous aspect of their biology is their elaborate tunnel systems. *Egernia striata* burrows are a very important feature of the Australian sandy deserts; they are used as diurnal retreats by various geckos, including *Heteronotia binoei, Nephrurus levis*, and *Rhynchoedura ornata*. These excavations are also exploited as refuges from predators and the elements by diurnal lizards including *Varanus eremius* and *Amphibolurus isolepis*. We also encountered snakes *(Pseudechis australis* and *Pseudonaja nuchalis)* in these tunnel systems.

Both *Egernia* species dig their own burrow systems, but these differ substantially in structure and complexity.

E. inornata burrows are usually fairly simple U-shaped tubes about a 30 cm beneath the surface at their deepest spot with but one arm of the "U" open (this is the sole entrance to the burrow); the other arm the the "U" typically stops just below the surface of the ground and is used as an escape hatch by breaking through in an emergency. *E. inornata* individuals may often have two such burrows 10-20m apart. The sand removed from *inornata* burrows is typically spread out in a thin, fan-like, layer radiating out from the entrance (lizards have been observed pushing sand out and smoothing it over with their forefeet). This entrance most often faces north or northwest (Table 1 and Figure 2).

Table 1. Compass directions burrows face among 88 *Egernia inornata* and 300 *Egernia striata*.

Direction	*E. inornata* N	*E. inornata* %	*E. striata* N	*E. striata* %
N	17	19.3	12	4.0
NNE	7	8.0	9	3.0
NE	5	5.7	18	6.0
ENE	3	3.4	14	4.7
E	2	2.3	23	7.7
ESE	1	1.1	9	3.0
SE	4	4.6	15	5.0
SSE	3	3.4	24	8.0
S	9	10.2	40	13.3
SSW	1	1.1	32	10.7
SW	4	4.6	29	9.7
WSW	1	1.1	24	8.0
W	6	6.8	22	7.3
WNW	4	4.6	13	4.3
NW	18	20.5	11	3.7
NNW	3	3.4	5	1.7
Totals	88	100.1	300	100.1

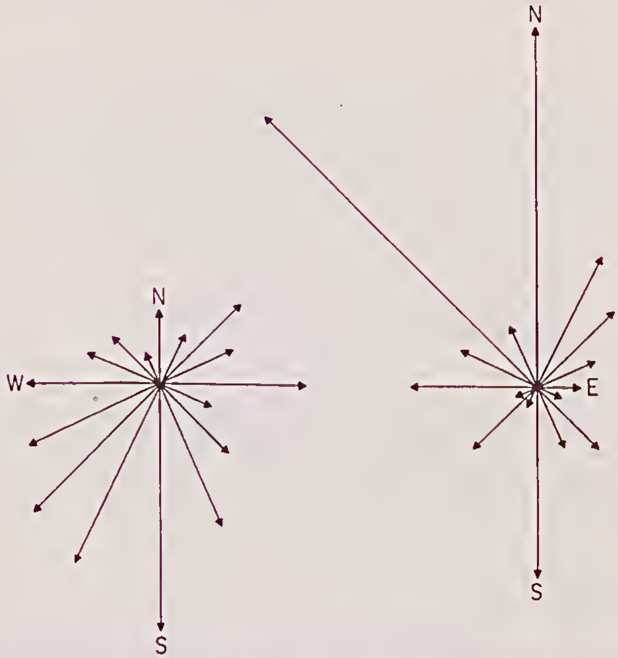

Figure 2. Directions of major burrow entrances among 300 *Egernia striata* burrow systems (left) and for 88 *Egernia inornata* tunnels (right). Data are given in Table 1. The length of each arrow is proportional to the percentage of burrows facing that direction.

E. striata dig a much more elaborate burrow system, with several interconnected openings often as far as 1 m apart, and vaguely reminiscent of a tiny rabbit warren. Burrows of *striata* are usually deeper than those of *inornata*. Most of the sand removed from a *striata* burrow is piled up in a large mound outside one "main" entrance, which usually points south or southwest (Table 1 and Figure 2).

We can only speculate as to why the two species construct such different burrows and why they have such curious compass orientations. Moving all of the sand out of a single opening of an extensive and complex *striata* burrow system would seem to involve considerable extra energetic expenditure: what could be the counterbalancing benefits? Deep sand is a darker red than surface sand and such tailings give away the positions of burrow entrances. Perhaps consolidating all such conspicuous diggings in one massive pile reduces the likelihood that they will attract undesirable attention (these mounds themselves are sometimes hidden inside *Triodia* tussocks). Alternatively, the mound itself could serve as a convenient lookout and/or basking platform (the southerly orientation might facilitate the latter function by providing a sloping surface roughly perpendicular to the sun's rays from the north). The north-facing entrances to *inornata* tunnels are more difficult to explain, but could also be related to thermoregulation in that a lizard sitting in such an entrance would be exposed to the relatively warm northern sky. Thus interpreted, the interspecific difference in burrow orientation would be attributed to the observed difference in extent of diurnal activity.

THERMAL RELATIONS

Body temperatures were measured with thin-bulb cloacal thermometers immediately upon unearthing *Egernia*. We also obtained some such temperature measurements on more active individuals by shooting them, usually at the entrances of their burrows. Thus estimated, mean body temperature of 103 *inornata* was 30.1°C (standard deviation 3.48), while the average temperature of 145 *striata* was 30.9°C (S.D. = 3.98). Maximum voluntary body temperature observed for *inornata* was 37.9, whereas for *striata* was 38.5°C. Average air temperatures 1 m above ground at the time of capture of these same animals were 26.5 and 28.1°C, respectively (S.D.'s 5.31 and 4.88). Body temperatures and air temperatures are significantly positively correlated (r's = .787 and .736). Thermoregulation appears to be relatively passive (Huey and Slatkin 1976), as the slopes of linear regressions of body temperatures on air temperatures are fairly steep (.516 and .600).

FORAGING AND DIETS

During daylight hours (and perhaps at night as well), *E. inornata* sometimes sit-and-wait in the mouth of their burrows, from which position the lizards make short forays to capture large insect prey nearby. Both species probably forage more actively at night although this is difficult to document. *E. striata* were occasionally found abroad at night.

Diets of both species are fairly catholic (Tables 2 and 3), consisting of a fairly wide variety of arthropods as well as an occasional lizard or shed skin and some plant materials (various seeds, flowers, and some "fruits"). Some *E. striata* consume large numbers of termites, particularly after heavy rains (one actually found a damselfly in the desert).

REPRODUCTION

Like other *Egernia* (Cogger 1975), both of these species of skinks retain their eggs internally and are live-bearing, giving birth to 1-4 young. Number of litters of sizes 1, 2, 3 and 4 in *inornata* was 7, 16, 9 and 0 (mean = 2.1), respectively, whereas those among *striata* were 2, 6, 7 and 4 (mean 2.61). Total litter weight, expressed as a percentage of a female body weight, a crude estimator of a female's energetic investment in reproduction, averages 13.4% in 21 female *inornata* with full-term embryos versus 10.1% in 18 *striata*, females (S.D.'s 2.4 and 4.3, respectively). In *striata*, gravid females with full-term embryos were found from late October through mid-January (with a peak in December), but reproduction in *inornata* seems to be spread out over a longer period of time, from late September through early May (with apparent peaks in December and in March, suggesting two litters). Juveniles of *striata* may remain in their mother's burrow for some time as evidenced by excavating fairly large (42-44 mm snout-vent length) juveniles in the same burrow system with an adult.

Table 2. Summary of stomach contents of 124 *Egernia inornata.*

Food Item	Number	Volume cc.	% of Total Number	% of Total Volume	Frequency
Centipedes	2	0.35	.23	1.05	2
Isopods	3	0.12	.35	0.36	2
Spiders	14	1.17	1.64	3.51	11
Scorpions	pts.	0.10	—	0.30	1
Ants	524	11.78	60.79	35.2	113
Wasps	7	.35	.81	1.05	6
Grasshoppers	12	2.25	1.39	6.75	12
Cockroaches	6	1.15	.70	3.45	5
Phasmids	1	.40	.12	1.19	1
Mantids	1	.02	.12	.07	1
Beetles	43	3.52	4.99	10.55	28
Termites	219	2.38	25.41	7.14	11
Hemiptera	9	.31	1.04	.93	10
Diptera	5	.31	.58	.93	2
Lepidoptera	1	.15	0.12	.45	1
Insect Larvae	11	1.63	1.28	4.89	4
Unidentified Insects	—	.37	—	1.11	17
Lizards	4	0.98	0.46	2.94	4
Plant Materials	—	3.00	—	9.00	27
Unidentified Partially Digested Material	—	3.01	—	9.03	60
Totals	862	33.35	100.0	100.0	124

Table 3. Summary of stomach contents of 190 *Egernia striata.*

Food Item	Number	Volume cc.	%of Total Number	%of Total Volume	Frequency
Centipedes	3	0.80	.04	.71	3
Isopods	1	0.02	.01	0.02	1
Spiders	15	1.02	.22	.91	15
Scorpions	1	0.03	.01	0.03	1
Odonata	1	.03	.01	.03	1
Ants	725	11.22	10.65	9.98	133
Wasps	7	.29	.09	.26	7
Grasshoppers	8	.82	.10	.73	10
Cockroaches	16	2.65	.23	2.36	16
Phasmids	2	.03	.03	.03	1
Beetles	59	8.54	.87	7.60	46
Termites	5934	75.83	87.15	67.46	74
Hemiptera	12	.32	.18	.28	10
Lepidoptera	1	.10	0.01	.09	1
Insect Larvae	26	1.18	.38	1.05	8
Unidentified Insects	—	.69	—	.61	16
Vertebrates	—	5.20	—	4.63	26
Plant Materials	—	3.64	—	3.24	21
Totals	6811	112.41	100.0	100.0	190

ACKNOWLEDGEMENTS

This research was made possible by financial support from the Guggenheim Memorial Foundation and the National Geographic Society.

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SACRED IBIS IN SOUTH-WESTERN AUSTRALIA

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INTRODUCTION

The Sacred Ibis *(Threskiornis aethiopica)* in its sub-species *molucca* (also known as White Ibis) occurs in the Moluccas, the lowlands of New Guinea and large areas of Australia. Such distribution might be termed trans-equatorial. Vagrants reach Tasmania and New Zealand but on the mainland of Australia, the range of the Sacred Ibis is discontinuous but generally spans the continent. Published distribution maps (Slater, 1970; MacDonald, 1973; Busby and Davies, 1977; Pizzey,1980) and banding recoveries documented by Carrick (1962), suggest a continuous distribution across tropical Australia, and southwards along the east coast. Continuity seems to exist between northern and eastern Australia, and, at least in the wet season, between the Kimberley Division and the rest of northern Australia. Banding evidence indicates that movements of Sacred Ibis, from breeding-places in central Victoria, occur in two directions along the east coast; a few birds fly to northern Queensland, while other groups of Sacred Ibis disperse along the south-east coast. These patterns of distribution have been mapped, using some of the information in accordance with the published maps and also personal scrutiny of the available records of Sacred Ibis (Fig. 1).

The importance of geographical controls on Australian bird distributions has been discussed by Gentilli (1949). Arid and semi-arid regions appear to offer an effective barrier to Sacred Ibis. Regional differences in climate and the availability of wetland habitats, may account for the fact that its status varies widely: it is abundant in the northern and eastern parts of Australia, while small colonies are found in south-western Australia; elsewhere the bird is rare.

This paper will consider aspects of the distribution and ecology of the Sacred Ibis in south-western Australia. Much of it is based on personal observations, except where explicitly acknowledged, and is intended to supplement more the detailed studies of a decade or two ago (e.g. those of Carrick, 1959; 1962), and recently by Cowling and Lowe (1981).

INVASION OF SACRED IBIS INTO SOUTH-WESTERN AUSTRALIA

Sacred Ibis have only recently colonised the south-west of Western Australia. Although W.B. Alexander, in his ornithological notes in Australia, has several observations of Straw-necked Ibis *(T. spinicollis)* in south-western Australia, he includes no mention of Sacred Ibis (unpublished documents between 1912 and 1925, Canberra). Also they were not listed by D.L. Serventy in his 1948 publication on the birds of the Swan River District. In 1952, when a very low rainfall was recorded in the north of the State, small numbers of Sacred Ibis moved south from the Kimberley Division. Individuals were noticed among the flocks of Straw-necked Ibis in various coastal localities between Perth and Busselton. Observations in regions more distant from the sea were rare; however in December 1957, Sacred Ibis were observed near Narrogin, at Lake Toolibin (Serventy and Whittell, 1976).

In autumn 1968, there was another small irruption of Sacred Ibis, but this time the species became permanently established in the south-west. Jenkins (1968 and 1971) described small flocks of birds in Wanneroo and Cockburn (Lake Mariginiup, Lake Jandabup, North Lake and Bibra Lake), usually in the